UNIVERSITI PUTRA MALAYSIA

REPRODUCTIVE BIOLOGY AND PHENOLOGICAL OBSERVATION OF THREE CALAMUS SPECIES IN PENINSULAR MALAYSIA

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REPRODUCTIVE BIOLOGY AND PHENOLOGICAL OBSERVATION OF THREE *CALAMUS* SPECIES IN PENINSULAR MALAYSIA

By

MOHD ZAKI BIN HJ ABDULLAH

Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of Science in the Faculty of Forestry Universiti Putra Malaysia

June 2000

THIS M.SC THESIS IS SPECIALLY DEDICATED TO……..

NORFAIZAH BINTI AHMAD FUAD…….umi

AINA IZZATI…….aina

AIMAN IRFAN…….aiman

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

REPRODUCTIVE BIOLOGY AND PHENOLOGICAL OBSERVATION OF THREE *CALAMUS* SPECIES IN PENINSULAR MALAYSIA

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June 2000

Chairman : Associate Professor Kamis Awang, Ph.D.

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Knowledge on reproductive biology is important for genetic improvements program. This study aimed at determining the reproductive biology and phenological behavior of *Calamus palustris* Griff. var. *malaccensis* Becc., *Calamus scipionum* Loureiro, and *Calamus ornatus* Blume., from natural populations. Seven sites throughout Peninsular Malaysia i.e. Hutan Simpan Mata Ayer, Bukit Larik, Setia Enggor, Linggi, Batu Kurau, Bukit Besi and Ulu Serting were chosen for the studies. In the basic study, observations on the reproductive biology including floral morphology, phenology and regeneration behaviour were made.

For the study on floral morphology, only *C. scipionum* and *C. palustris* were selected. The flower structures of *C. scipionum* and *C. palustris* were

similar. The differences noted were in the colour and sizes of the flowers. The male flowers of *C. scipionum* were dark brown and yellowish in *C. palustris*. The female flowers of *C. palustris* were pale yellow in colour and dark brown in *C.scipionum.* In terms of flower size, both male and female flowers of *C. scipionum* were bigger than those of *C. palustris* and for each species female flowers were bigger than male flowers.

C. scipionum had longer inflorescences and main rachis compared to *C. palustris*. However, there were no differences in terms of the number of main rachis and rachilla per inflorescence and rachilla length. In the female inflorescence, *C. scipionum* had longer inflorescence, longer main rachis and also contained more rachilla compared to *C. palustris.*

Differences in the timing of flowering and fruiting were observed among the different climatic zones in all the three species. Fruit production took 8-9 months for *C. palustris* and 12-13 months for *C. scipionum* and *C. ornatus.* However, the variation on number of *C. palustris* wildings occurring under the rubber plantation and forested areas showed no significant difference. The information gained for this study can be used for breeding and genetic improvement programme for these species.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

BIOLOGI MEMBIAK DAN PEMERHATIAN FENOLOGI KE ATAS TIGA SPESIES *CALAMUS* DI SEMENANJUNG MALAYSIA

Oleh

MOHD ZAKI BIN HJ ABDULLAH

Jun 2000

Pengerusi : Profesor Madya Kamis Awang, Ph.D.

Fakulti : Perhutanan

Pengetahuan mengenai biologi pembiakan adalah sangat penting sebagai asas program pembaikbiakan genetik di masa hadapan. Kajian ini bertujuan untuk menerangkan mengenai biologi pembiakan dan fenologi bagi spesies *Calamus palustris* Griff. var. *malaccensis* Becc., *Calamus scipionum* Loureiro, dan *Calamus ornatus* Blume., daripada populasi semulajadi. Tujuh kawasan dari seluruh Semenanjung Malaysia iaitu Hutan Simpan Mata Ayer, Bukit Larik, Setia Enggor, Linggi, Batu Kurau, Bukit Besi dan Ulu Serting telah dipilih untuk kajian ini. Melalui kajian asas yang merangkumi sistem pembiakan termasuk biologi pembungaan, fenologi dan penentuan sifat pertumbuhan semulajadi telah dijalankan.

Bagi kajian morfologi bunga, hanya spesies *C. palustris* dan *C. scipionum*

yang dikaji. Kedua spesies mempunyai struktur bunga yang sama. Perbezaan utama wujud dari segi warna dan saiz bunga iaitu warna bunga jantan *C. scipionum* ialah perang kegelapan dan kekuningan bagi *C. palustris*. Bunga betina *C. palustris* berwarma kuning kecerahan dan perang kegelapan bagi *C. scipionum*. Kedua-dua bunga jantan dan betina *C. scipionum* mempunyai saiz bunga yang lebih besar berbanding *C. palustris* dan bunga betina setiap spesies adalah lebih besar dari bunga jantan.

C. scipionum mempunyai jambak bunga dan axis peringkat pertama yang lebih panjang berbanding *C. palustris*. Walaubagaimanapun, tiada perbezaan di antara bilangan axis peringkat pertama, rakis untuk sejambak bunga dan panjang rakis. *C. scipionum* mempunyai jambak bunga serta axis peringkat pertama bunga betina yang panjang dan mengandungi lebih rakis berbanding *C. palustris*.

Pemerhatian mengenai jangkamasa berbunga dan berbuah bagi ketiga-tiga spesies telah dilakukan pada zon cuaca yang berbeza. Pengeluaran buah bagi *C. palustris* mengambil masa selama 8-9 bulan manakala 12-13 bulan bagi *C. scipionum* dan *C. ornatus*. Walaubagaimanapun, variasi bilangan anak liar *C. palustris* ke atas kawasan ladang getah dan hutan menunjukkan tiada perbezaan yang bererti. Maklumat yang diperolehi dari kajian ini dapat digunakan sebagai asas dalam meningkatkan program pembiakan dan genetik bagi spesies tersebut.

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May Allah, the most Generous, bless them all.

I certify that an Examination Committee met on 12 June, 2000 to conduct the final examination of Mohd. Zaki bin Hj. Abdullah on his Master of Science thesis entitled "Reproductice biology and phenological observation of three *Calamus* species in Peninsular Malaysia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

(MOHD ZAKI BIN HJ ABDULLAH)

Date: 28 JULY 2000

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Acuminate	-	ending in a narrowed, tapering point with concave sides.
Catkin	-	spike like inflorescence of unisexual flowers.
Cirrus	-	climbing organ of rattans developed from an extension of the leaf tip.
Diaspore	-	the dispersal unit; in the case of most rattans this consists of part of the seed, after the outer seed coat (sarcotesta) has been removed.
Ellipsoidal	-	a solid object which is elliptical in section.
Glaucous	-	pale bluish-green or with a whitish bloom which rubs off.
Gynoecium	-	the female part or pistil of a flower, consisting, when complete, of one or more ovaries with their styles and stigmas.
Internode	-	the portion of the stem between two nodes.
Leaflet	-	one part of a compound leaf.
Ocrea	-	an extension of the leaf sheath beyond the base of the petiole.
Perianth	-	the floral leaves as a whole, including sepals and petals if both are present.
Ruminate	-	Referring to endosperm structure, penetrated by fine dark intrusions of the seed-coat.
Sarcotesta	-	the fleshy outer seed coat.
Sessile	-	Without a stalk.
Sheaths	-	the basal tubular part of the leafwhich encloses the stem.
Sterile	-	failing to complete fertilization and produce seed as a result of defective pollen or ovules; not producing seed capable of germination; lacking functional sexual organs.
Subcirrate	-	a type of leaf in which, although a true cirrus is not present, the terminal portion of the rachis bears very small, distant leaflets.

CHAPTER I

INTRODUCTION

Rattan is a non-timber product of the forest and is becoming an important resource after timber. There are many uses of rattan including the production of furniture, panelling, walking sticks, mats, baskets, sun hats and other products using modern and traditional designs and motives. However the main finished product is furniture and it has become a multi-million dollar business.

In recent years, there has been a sharp increase in demand for furniture especially from Japan, Europe and the United States of America (USA). Singapore was the clearing-house for practically the entire rattan output of the Southeast Asia and the western Pacific at the turn of the 20th century. Singapore and Hong Kong, without raw rattan resources of their own, have been playing the lucrative role of the middleman from the beginning of international trade in rattans. They have been importing, processing and then re-exporting of rattan products (Manokaran, 1990).

Malaysian Timber Industrial Board (1997) reported that the export figures of rattan furniture have increased tremendously from RM2.07billion in 1996 to RM2.61 billion in 1997.

It was estimated that a total 37,248 hectares of rattan plantation need to be established annually to sustain the present demand of rattan (Aminuddin and Nur

Supardi, 1991). According to Mohd. Zaki and Aminuddin (1997), there is less than 30,000 hectares of land planted with rattans in Malaysia. Therefore to ensure a perpetual supply to the furniture industry of Malaysia, there is an urgent need to plant more rattan. But, before establishing large-scale plantations, research on various aspects of rattan species should be undertaken because knowledge is still lacking, especially on reproductive biology.

In Malaysia, research on silviculture aspects of some commercial rattans e.g. *Calamus manan, C. tumidus* and *C. caesius* have been carried out since their introduction as plantation species but comprehensive research on genetic improvement is still limited. To develop a usable genetic improvement programme, a detailed knowledge on their reproductive biology must be incorporated. Therefore it is hoped that this study could be the basis for further genetic improvement programme especially for rattan species.

The scope of reproductive biology in this context includes flower morphology and reproductive phenology of the species. In addition, usage of the right choice of planting materials is also essential.

Thus, the objectives of this study were;

i. to determine the reproductive biology of two *Calamus* species

ii. to examine the stages and patterns of flowering and fruiting of three *Calamus* species and,

iii. to examine the regeneration behaviour of *C. palustris.*

It is hoped that information gathered from this study will provide a better understanding about the reproductive biology and phenology of these species.

CHAPTER II

LITERATURE REVIEW

Rattan

Rattans constitute about 600 different species in the world. They are divided into thirteen genera with ten genera found occurring in the Southeast Asian and neighbouring regions of Sumatra, Java, Borneo, Sulawesi, New Guinea, Fiji, the Philippines, Peninsular Malaysia, Thailand, Sri Langka, north-eastern, and southern parts of the Indian sub-continent, southern China, Vietnam, Laos, Cambodia, Burma and Australia (Dransfield, 1992). They are *Calamus, Daemonorops, Korthalsia, Plectocomia, Plectomiopsis, Myrialepis, Calospatha, Ceratolobus, Pogonotium* and *Retispartha.* Elsewhere, 3 genera (i.e. *Laccosperma, Eremosphatha* and *Oncocalamus*) of rattans are found only in West Africa.

However, according to Dransfield and Manokaran (1994) there are about one hundred and ninety-four or about one-third of all rattan species found in Malaysia. *Calamus* is the most represented genus with 113 species followed by *Daemonorops* (47 species), *Korthalsia* (19 species), *Plectocomiopsis* (5 species), *Plectocomia* (4 species), *Ceratolobus* (4 species) and one species each of *Myrialepis, Calospatha* and *Retispatha. Calospatha* and *Retispatha* are endemic to Malaysia (Dransfield, 1992).

Botanical Description

Rattans are spiny climbing plants belonging to the sub-family *Calamoideae* (Uhl and Dransfield, 1987). Dransfield (1979, 1980) has described the taxonomy of rattans of Peninsular Malaysia in great detail. The genera described are *Korthalsia, Plectocomia, Plectocomiopsis, Ceratolobus, Calospatha, Myrialepis, Daemonorops* and *Calamus* (Dransfield, 1979) and *Pogonotium* (Dransfield 1980).

The genus of rattan in this study is *Calamus Linn.* It is distributed in Southeast Asia, where it is a conspicuous member in most forests. The majority of *Calamus* species are climbers. Some have a solitary unbranched stem whereas others are clustered. All species are dioecious and pleonanthic with axillary inflorescences (Uhl and Dransfield, 1987).

The inflorescences of the *Calamus* species are distributed along the main axis, which terminates in a long whiplike climbing organ armed with hooklike spines (flagellum). The vertical position of the inflorescences depends on the height of the flowering stems and on where the flagellum is anchored.

The rachilla of *Calamus* pistillate inflorescences bear flowers in diads, which consist of a pistillate flower and a sterile staminate flower. In the staminate inflorescences the flowers are solitary and distichously arranged along the rachilla. During anthesis the three stigmatic lobes in the pistillate flowers

gradually bend, whereby the receptive surfaces becomes exposed. The staminate flowers have six widely exposed anthers.

The sterile staminate flowers in pistillate inflorescences are similar to the functional staminate flowers, but have empty anthers. Female flower is usually larger than the male, with calyx shallowly 3 lobed; corolla with 3 petals; staminodes 6 joined basally to form a cup-like ring; ovary tipped with 3 stigmas and covered with reflexed scales; locules 3 with one ovule in each. Fruits are variously shaped covered in reflexed scales.

It produces only one seed which is covered in thin to thick sarcotesta, the "diaspore" is very variable in shape, frequently deeply pitted and grooved, sometimes very sharply angular. Endosperm homogeneous or ruminate. Embryo basal, or lateral. Seedling leaf bifid or pinnate.

Three species of *Calamus* were selected for this study i.e. *Calamus palustris* Griffith var. malaccensis Becc. , *Calamus scipionum* Lour. and *Calamus ornatus* Blume.

***Calamus palustris* Griffith var. *malaccensis* Becc.**

Dransfield (1979) described the cane as glossy, yellowish that posses an excellent general appearance. Briefly the description is as follows: leaf sheath bright green or some times yellowish green when exposed to sunlight, large spines up to 3cm, scattered with smaller spines in between, knee conspicuous, narrow